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GENERAL PERFORMANCE AND DESIGN OBJECTIVES
FOR FIELD TEST SETS (U)

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(6) GENERAL PERFORMANCE AND DESIGN OBJECTIVES
FOR FIELD TEST SETS (10)

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Prepared by:
John R. Davis

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ABSTRACT: ~~This report is a documentation of those~~
performance and design objectives which ~~are~~ ^{WERE} generally
common to all field-type test sets developed in the
Air and Surface Weapons Program of the Naval Ordnance
Laboratory. ^{WERE PRESENTED.} For maximum usefulness the objectives
~~have been stated as specifically as possible.~~
Individual design problems will, ~~however,~~ require
supplementary objectives and possibly exceptions
~~to this document,~~ to objectives presented.

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In order to provide a general basis for field test set design, the information in this report has been compiled. The fact that the design characteristics described here are those of a portable, ruggedized, self-contained test set is not intended to preclude the development of rack-mounted test equipment for those situations in the field, where such equipment would best meet the needs. It is anticipated, in fact, that each test set designed will have special requirements which will be covered in a supplement to this general document.

Acknowledgement is hereby given to B. N. Singleton and S. A. Humphrey, authors of reference 2.2.1, and A. J. Gardenhour, Jr., author of reference 2.3.1. Much of the material for this document was drawn from these two reports, which are highly recommended to designers of the test equipment.

MELL A. PETERSON
Captain, USN
Commander

A. J. WADMAN
By direction

NAVORD REPORT 6646

CONTENTS

	Page
1. SCOPE	1
2. APPLICABLE DOCUMENTS	1
2.1 Specifications	1
2.2 NAVORD Reports	1
2.3 Other Documents	1
3. OBJECTIVES	2
3.1 General	2
3.2 Functional	2
3.2.1 Presentation of Information	2
3.2.2 Human Engineering of Control Panels	2
3.2.3 Fail-Safe	3
3.2.4 Effect on Tested Device	3
3.2.5 Rejection and Reset Control	3
3.3 Structural	4
3.3.1 Housing	4
3.3.2 Component Mounting	4
3.3.3 Heat Dissipation	4
3.3.4 Waterproofing	4
3.3.5 Door in Dust Cover	5
3.3.6 Standardization	5
3.4 Environmental	6
3.4.1 Temperature	6
3.4.2 Humidity	6
3.4.3 Vibration	6
3.4.4 Shock	6
3.5 Calibration	6
3.6 Adaptability	7

NAVORD REPORT 6646

ILLUSTRATIONS

	Page
Figure 1. Test-Set Control Panel Layout	8
Figure 2. Test-Set Structure	9

NAVORD REPORT 6646

GENERAL PERFORMANCE AND DESIGN OBJECTIVES FOR FIELD TEST SETS(U)

1. SCOPE

1.1 This document describes the general performance and design objectives applicable to the mechanical and electrical features of field test equipment developed in the Air and Surface Weapons Program of the Naval Ordnance Laboratory. In general, one type of equipment is designed for use by all field activities.

2. APPLICABLE DOCUMENTS

2.1 Specifications

2.1.1 MIL-T-945A, Test Equipment for Use with Electronic Equipment: General Specifications.

2.1.2 MIL-C-4150E, Case, Carrying and Storage, Shock and Waterproof.

2.1.3 MIL-E-16400B(Ships), Electronic Equipment, Naval Ship and Shore: General Specifications.

2.2 NAVORD Reports

2.2.1 NAVORD Report 4257 of 27 Jul 1956, A New Concept in Test-Set Design

2.2.2 NAVORD Report 5339 of May 1956, Human Engineering Principles for Mine Test-Set Design.

2.3 Other Documents

2.3.1 New York University SETE 230/2.1.1 of 9 Oct 1958; Proceedings of Second Annual Joint Military-Industrial Electronic Equipment Symposium, Test Program Planning and Test Philosophy for NOL Special Weapons Programs (Conf).

NAVORD REPORT 6646

2.3.2 Department of Commerce OTS PB-121839, U. S. Naval Electronics Laboratory Reliability Design Handbook. (Lib. of Cong. TK7870.U6)

2.3.3 NAVORD OS 7888 (In preparation), Military Specifications, Calibrator, Electrical Instrument, T-3028.

2.3.4 MIL-STD-108D, Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.

3. OBJECTIVES

3.1 General. In naval ordnance the test equipment occupies a supporting major role in a complete weapon development. A complete weapon capability cannot, in fact, be obtained until the test equipment is provided in the various logistic locations required for a particular weapon. (To establish test philosophy it is mandatory to first solidify the stockpile-to-target sequence for the weapon system.) The over-all objective of the field test equipment is to give the fleet the capability required to deliver weapons that will meet the weapon military characteristics.

3.2 Functional. The planning of test sets should be started early in any weapon development program to insure that devious testing and calibrating systems are avoided. The specific functions to be performed by a test set will be indicated in supplemental performance and design objectives. General functional design goals are as follows:

3.2.1 Presentation of Information. A "go-no go" presentation of information, as typically represented by on-off lamp indicators or red-green areas on a meter dial, is preferred over the quantitative presentation.

3.2.2 Human Engineering of Control Panels. Principles of human engineering, as presented in NAVORD Report 5339, should be applied to the design of the control panel. Some design considerations for test-set control panels are as follows:

3.2.2.1 All controls and indicators should have labels above them.

3.2.2.2 Numbering or lettering of components should be from left to right.

NAVORD REPORT 6646

3.2.2.3 All cables and connectors should be numbered or otherwise positively identified. Color coding may be used as supplemental identification, but is never sufficient alone.

3.2.2.4 Cable receptacles should be mounted on the control panel and stacked with the larger or more bulky receptacles nearer the bottom of the panel except for the power receptacle and the fuse which should be near the top.

3.2.2.5 Clockwise movement of rotary controls should result in clockwise movement or increased reading of indicators.

3.2.2.6 Toggle switches should move up or to the right for the "ON" position.

3.2.2.7 The test-set control panel should generally be laid out according to Figure 1.

3.2.3 Fail-Safe. The electrical circuits should be designed to provide a reliable "fail-safe" feature. This means that a defective test set may reject a good device, but must never accept a faulty one.

3.2.4 Effect on Tested Device. Deterioration of any component of the device under test, as a result of the testing operation, should be kept to a minimum. Particular attention must be given to safety when a test set is to be used on a weapon in which a warhead is installed. The test set should have an energy source so limited that insufficient power is available to operate any functional component which might lead to detonation of the warhead.

3.2.5 Rejection and Reset Control. Provision should be made if feasible to prevent the normal removal of a tested item from the test set if the device has failed the test. Provision should also be made if feasible to prevent normal removal if the operator should fail to reset any part of the device requiring resetting before it can be used. If normal removal cannot be prevented, a positive indication should be provided on the test-set panel to show that complete resetting has been accomplished. It should be noted that an improperly designed monitor circuit will sometimes give a false indication that the component has been reset.

NAVORD REPORT 6646

3.3 Structural

3.3.1 Housing. The test set structure should include a panel, a channel-shaped rectangular chassis, a dust cover, and a carrying case. See Figure 2 for example. The chassis is attached to the back of the panel. The panel and the dust cover around the chassis form a waterproof unit which is mounted to flanges in the lower part of the carrying case. The removable cover also provides a waterproof seal for the protection of the panel and the accessories which it houses. A relief valve should be provided in the case to facilitate opening the cover under increased outside pressure and to permit safe opening in the event of decreased outside pressure. The size and weight of the test-set housing should be the minimum consistent with the functional and environmental requirements. Sizes and other characteristics of cases should comply with MIL-C-4150E.

3.3.2 Component Mounting. The large components should be mounted inside the chassis with their terminals extending through the chassis walls to the outside. Heavy components such as transformers should be mounted in corners with additional clamping to hold them solidly in place. Small components and all chassis wiring should be on the outside of the chassis. It is desirable that wiring and outside components should be mounted on only three sides of the chassis so that it will not be necessary to turn the set over during manufacturing and servicing operations. As an aid in trouble-shooting, it should be specified to the manufacturer that all condensers and resistors be mounted on terminal boards with adequate identification and spare terminals, and in addition that each component should be soldered in place with its own printed identification visible.

3.3.3 Heat Dissipation. Consideration should be given to the problem of heat dissipation if the test set uses power. Heat generating components should, if possible, be mounted near the panel, and approximately one square foot of exposed metal surface (not enclosed by a fiberglass case) should be allowed for dissipation of each 100 watts.

3.3.4 Waterproofing. The enclosing case should be "water-tight" as defined in MIL-STD-108D. Humidity conditions within

NAVORD REPORT 6646

the test set should be controlled through the use of a desiccant. All of the components which are panel-mounted or otherwise exposed should be equipped with gaskets and should be inherently waterproof. Each set should have a humidity indicator mounted in a prominent place on the panel so that the internal condition of the set can be visually checked and the desiccant renewed when necessary.

3.3.5 Door in Dust Cover. Except on very small test sets, a door should be provided in the dust cover for access to the desiccant and to permit calibration and change of tubes without removing the entire dust cover.

3.3.6 Standardization. Materials, processes and parts called for in the design should be consistent with good practice (See OST PB-121839, 2.3.2), should follow a set of standards such as those included in NAVORD Report 4257, and should be consistent with the specifications given in MIL-T-945A. Future difficulties in disclosure of the design and in procurement of the test set can be avoided by intelligent selection of such materials, processes and parts during design stages. The use of proprietary items will require complete justification and prior approval before incorporation in a design disclosure released to the Bureau of Ordnance. Component selection should include the following considerations:

3.3.6.1 Hermetically sealed components should be used whenever possible for protection against moisture and damage through rough handling.

3.3.6.2 Sealed fiberglass is preferable to paper base phenolic as a switch material.

3.3.6.3 Sealed meters should be chosen which permit zero adjustment, preferably by an external screw or by simple disassembly.

3.3.6.4 Electrolytic condensers should be avoided wherever possible to eliminate a future source of corrosion.

3.3.6.5 Only ruggedized vacuum tubes should be used, and these should be provided with tube clamps.

NAVORD REPORT 6646

3.3.6.6 Rectifiers should be either encapsulated or otherwise coated to prevent corrosion. Rectifiers having a higher rating than actually needed should be chosen to increase service life.

3.3.6.7 Wire-wound adjustable resistors (of the slide-tap variety) should not be used.

3.4 Environmental

3.4.1 Temperature. The test set should operate properly at ambient temperatures of 0°F. to 120°F. without recalibration, or after exposure to a temperature range extended to -65°F. and +160°F. followed by recalibration.

3.4.2 Humidity. The test set should operate properly without recalibration under extended exposure to 95 percent relative humidity under the temperature conditions described above.

3.4.3 Vibration. The test set should operate properly when recalibrated after exposure (without benefit of packaging other than the carrying case) to railroad-, ship-, and air-transportation vibration.

3.4.4 Shock. The test set should operate properly when recalibrated after being dropped on each corner and flat on the bottom from a height of 30 inches onto steel or concrete.

3.5 Calibration. The need for test-set calibration in the field should be an initial consideration in test-set design.

3.5.1 A secondary reference calibrator, T3028, (See NAVORD OS 7888) has been developed for use at forward field and ship locations. It will provide current, voltage, resistance, and time standards. The T-3028 Electrical Instrument Calibrator will employ a standard calibration plug and connector which will be common to all test sets. From this 37-pin connector, all calibration points are made accessible at a junction box of the T-3028 Calibrator. The test set should provide a receptacle inside the door of the dust cover to receive the standard calibration plug. A mating plug which contains several jumpers may be connected to the 37-pin receptacle during normal use of the tester.

NAVORD REPORT 6646

3.5.2 When the degree of reliability required is sufficiently high to justify it, test sets should include self-testing features to permit a certain degree of calibration verification as an integral part of the operating procedure. Where applicable, there should be added to the front panel of a test set a connector which contains, as an independent circuit, a number of resistors or completed circuits which correspond to the weapon under test, or preferably a circuit which causes any normally "ON" lights to go "OFF" and normally "OFF" lights to go "ON". By such a system, the operability of the test set may be established immediately before and after test.

3.6 Adaptability. Where practical, consideration should be given to adapting a single test set to the testing of similar components of two or more systems.

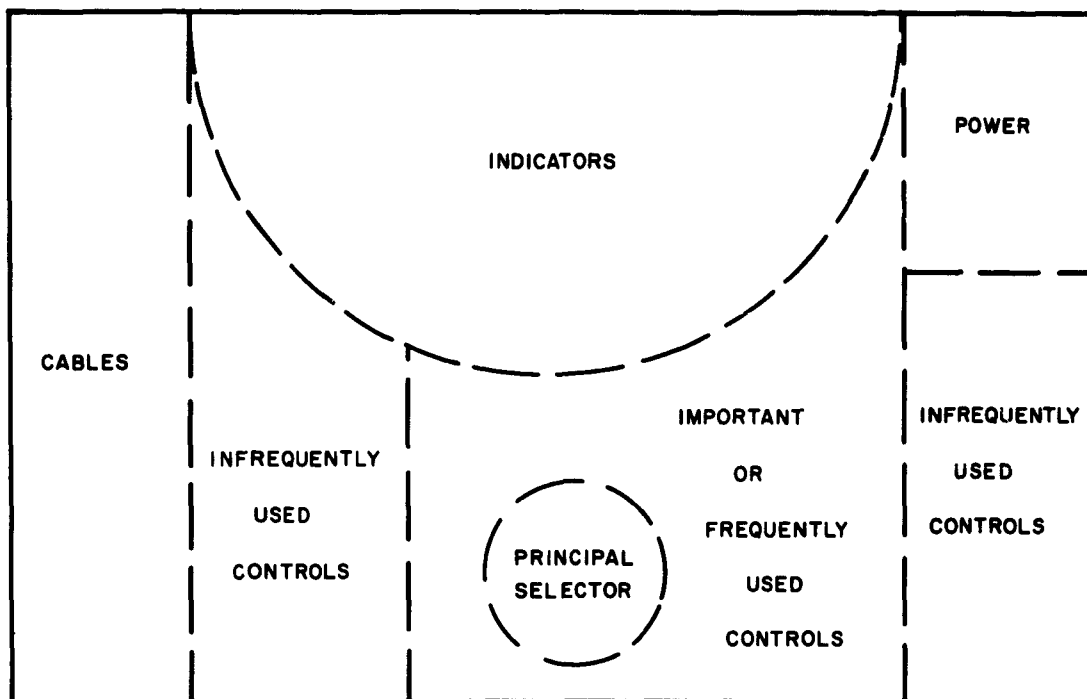


FIG. 1 TEST SET CONTROL PANEL LAYOUT

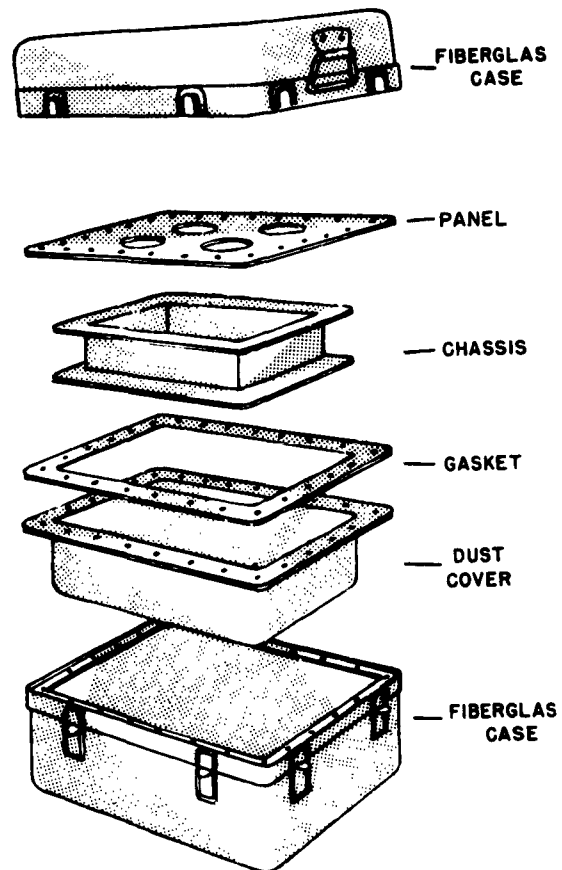


FIG. 2 TEST SET STRUCTURE

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